

Descriptions of genitalia of two Japanese species of the genus *Arichanna* (Lepidoptera, Geometridae), with male genital musculature and taxonomic comments on the subgenus *Icterodes*

Satoshi HASHIMOTO

Natural History Museum and Institute, Chiba, 955-2, Aoba-cho, Chuo-ku, Chiba, 260 Japan

Abstract The male and female genitalia of *A. melanaria* and *A. jaguararia* are described and figured with a key based on the genitalia. The male genital musculature and taxonomic comments on *Icterodes* are also given.

Key words Geometridae, *Arichanna*, *Icterodes*, genitalia, male genital musculature.

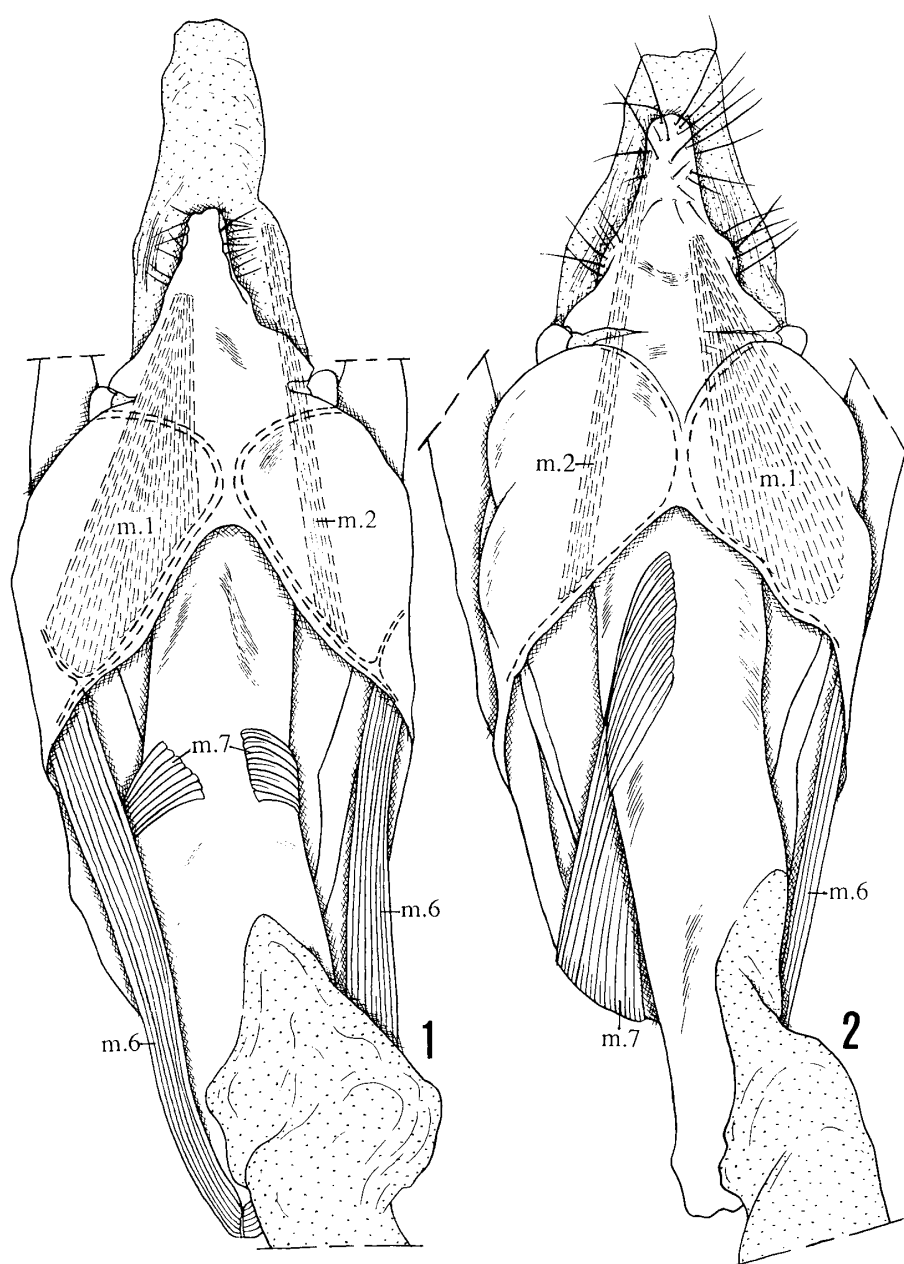
Arichanna Moore, 1868, is a large genus comprising five subgenera and about 90 described species, and is mainly distributed in Southeast Asia. The first subdivision of this genus was made by Hampson (1895). He and Prout (1915) divided *Arichanna* into three sections or subgenera, *Arichanna* s. str., *Icterodes* Butler and *Phyllabraxas* Leech, by the male secondary sexual characters such as antennal and hind tibial structures, respectively. Wehrli (1933, 1939) used the male genital characters for the division of the genus *Arichanna* and established the present classification. He subdivided the genus into six subgenera, *Arichanna* s. str., *Icterodes* Butler, *Phyllabraxas* Leech, *Paricterodes* Warren, *Epicterodes* Wehrli and *Dictyodea* Wehrli, based on the combination of the male antennal and genital structures. But, his arrangement of the species into each subgenus did not always depend on the above characters. In his studies of Nepal Himalayan species of *Arichanna*, Inoue (1970) mentioned that Wehrli's treatment must be critically reconsidered by observing female genitalia and he (1987) treated the subgenus *Dictyodea* as a junior subjective synonym of the genus *Alcis* Curtis. Sato (1987) studied the immature stages of three Japanese species, *A. tetrica* (Butler), *A. melanaria* (Linnaeus) and *A. jaguararia* (Guenée), and suggested that there are considerable differences between them. He also indicated that the studies of the larval characters are needed for the revision of the genus. Thus it is disputable whether each subgenus of the genus *Arichanna* deserves generic rank or not.

From Japan, only five species are known; three of them, *A. tetrica* (Butler), *A. pryeraria* Leech and *A. albomacularia* Leech, belong to the subgenus *Arichanna*, and the remaining two, *A. melanaria* (Linnaeus) and *A. jaguararia* (Guenée), to the subgenus *Icterodes*. Since no detailed studies on the genital structures of Japanese species have been done so far, I examined the genitalia and male genital musculature of *A. melanaria*, and *A. jaguararia*. The present paper provides the descriptions of the genitalia of *A. melanaria* and *A. jaguararia* with a key and figures. The taxonomic comments on the subgenus *Icterodes* and the male genital musculature are also given.

Genus *Arichanna* Moore

Arichanna Moore, 1868, *Proc. zool. Soc. Lond.* **1867**: 658.

Type-species: *Scotosia plagifera* Walker, 1866, *List Specimens lepid. Insects Colln Br. Mus.* **35**: 1686.



Figs. 1-2. *Arichanna* spp., male genitalia, dorsal view. 1. *melanaria*; 2. *jaguararia*.

Subgenus *Icterodes* Butler

Icterodes Butler, 1878, *Illust. typical Specimens Lepid. Heterocera Colln Br. Mus.* 2: ix.

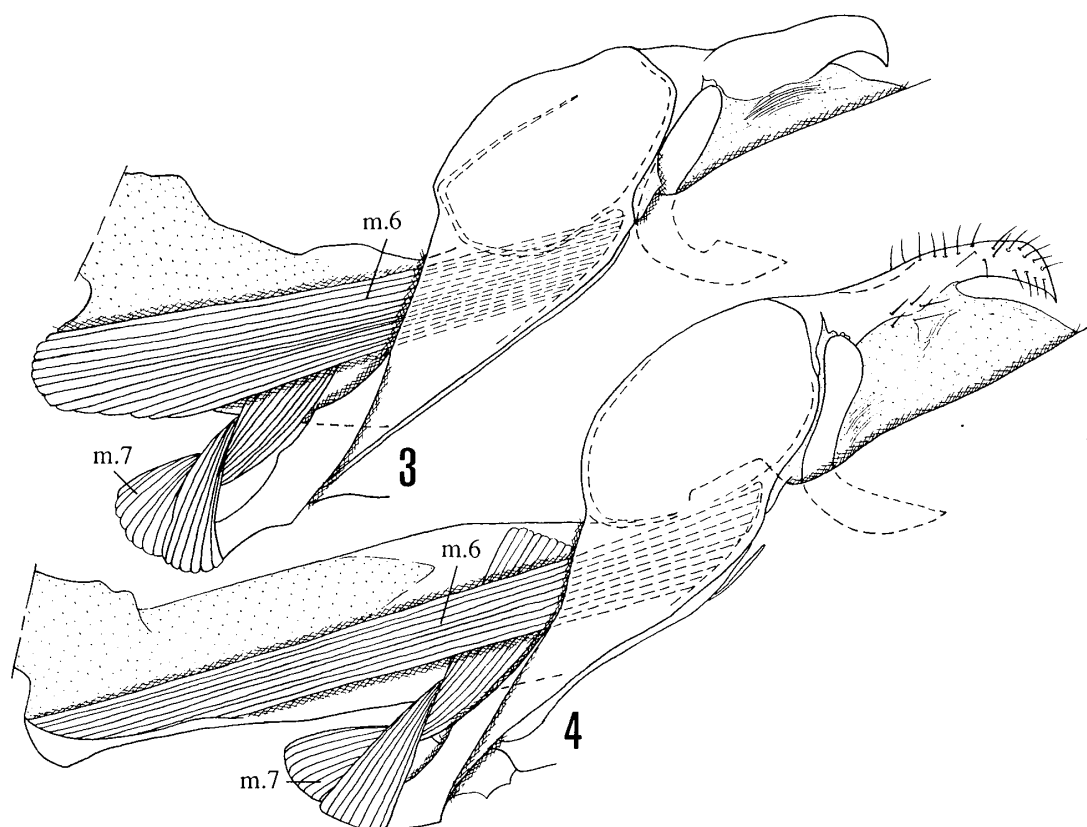
Type-species: *Rhyparia fraterna* Butler, 1878, *Illust. typical Specimens Lepid. Heterocera Colln Br. Mus.* 2: 53, pl. 37, fig. 9.

Rhyparia Hübner, [1825] 1816, *Verz. bekannter Schmett.*: 305. A junior homonym of *Rhyparia* Hübner, [1820] 1816 (Lepidoptera, Arctiidae).

Type-species: *Phalaena melanaria* Linnaeus, 1758, *Syst. Nat.* (Edn 10) 1: 521.

Hemipyrrha Grote, 1896, *Proc. ent. Soc. Lond.* 1896: XV. The objective replacement name for *Rhyparia* Hübner, [1825].

Type-species: *Phalaena melanaria* Linnaeus, 1758, *Syst. Nat.* (Edn 10) 1: 521.



Figs. 3-4. *Arichanna* spp., male genitalia, lateral view. 3. *melanaria*; 4. *jaguararia*.

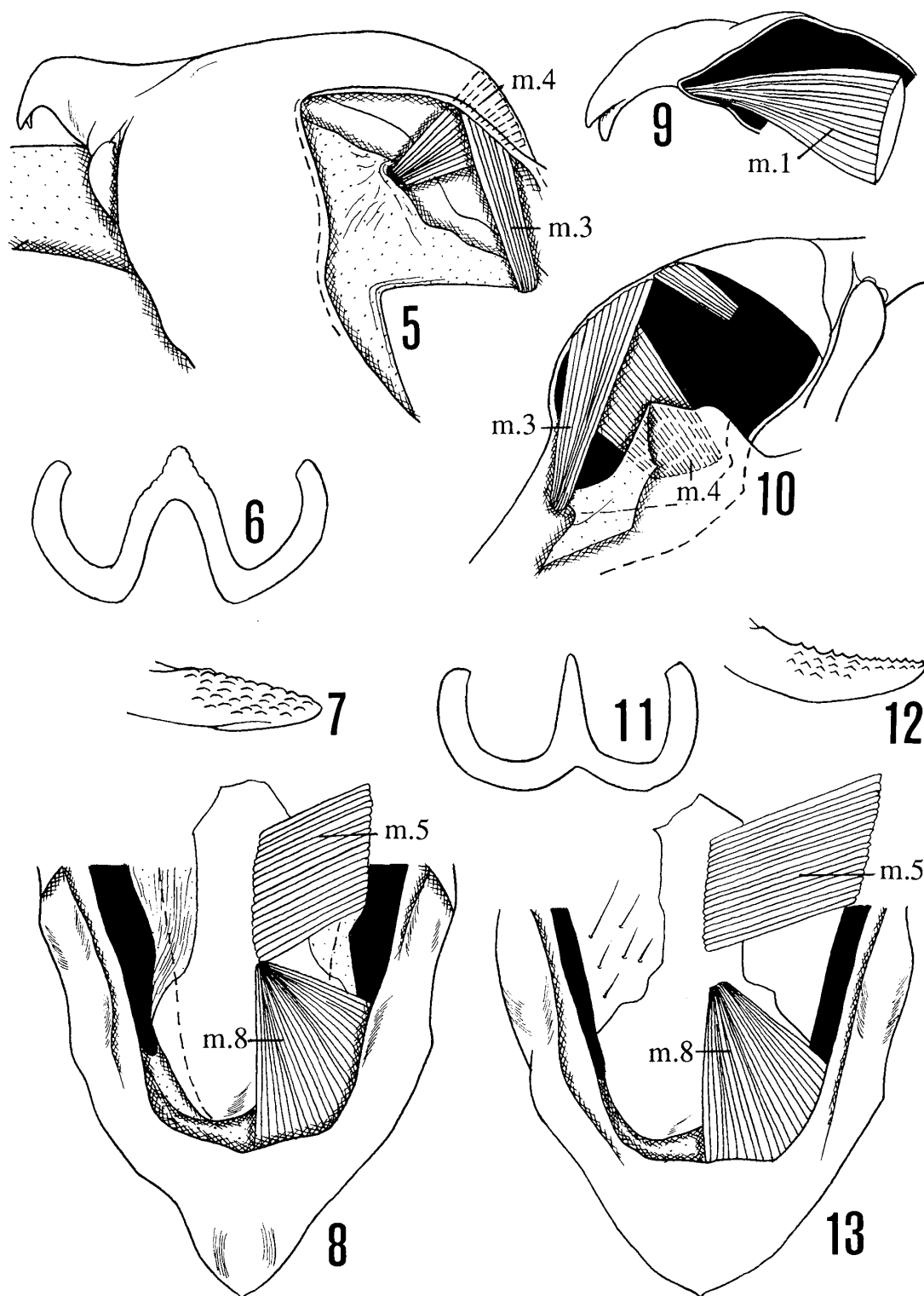
1. Description of external genitalia of *Icterodes*

Male genitalia (Figs. 1-19). Tegumen rounded. Tegumen and vinculum strongly fused each other, sclerotized laterally and formed a complete ring. Uncus triangle in ventral view, curving ventrally and with a bifurcate tip. Socii not developed. Gnathii well developed, fused each other ventrally, with a ventral projection covered with small protuberances. Juxta narrow except rounded base. Valva simple without any projections except ampulla and transtilla; sacculus slender, weakly sclerotized, about $3/5$ length of valva on ventro-proximal part; harpe lying at mesal portion of valva, weakly sclerotized, with short hairs; ampulla protruded ventrally, lying dorso-posteriorly to harpe, with many curved spines. Phallus almost as long as valva, with or without cornutus; right terminal end of phallus divided into two parts by a longitudinal groove, one of which is spatulate and the other is spinous.

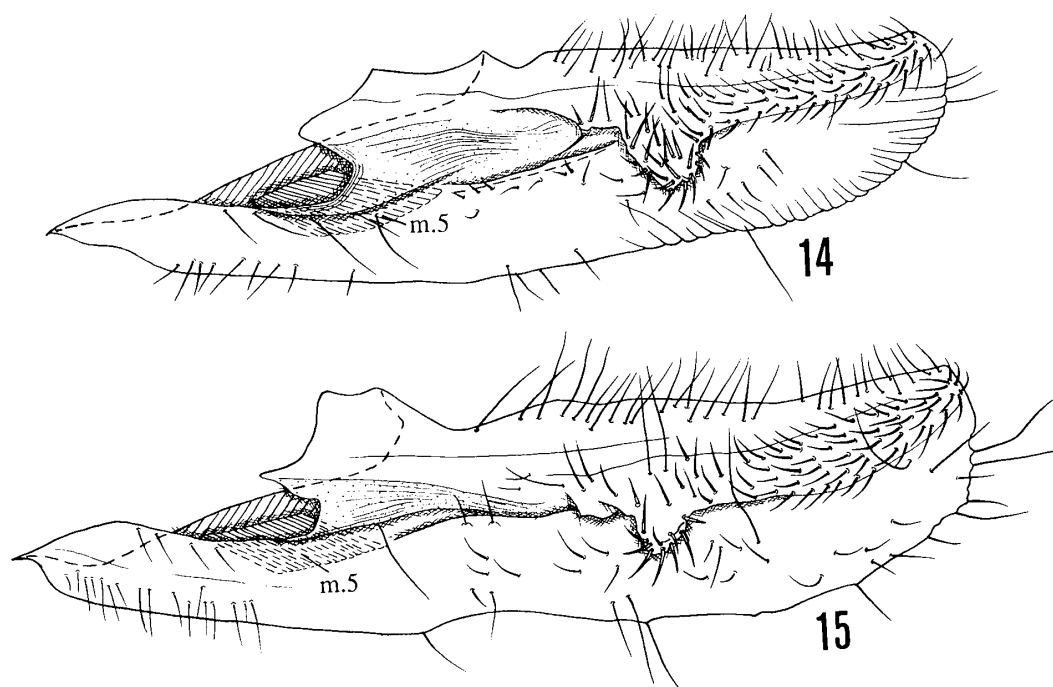
Female genitalia (Figs. 20-23). Corpus bursae membranous, with or without signum. Ductus bursae membranous, with many granules. Ductus seminalis originating on basal part of ductus bursae. Lamella postvaginalis developed or not developed. Papillae anales small; dorsal part of papillae anales widely membranous.

2. Male genital musculature

The number of muscles are mainly based on Forbes (1939) and Birket-Smith (1974). The male musculature system of the subgenus *Icterodes* is basically similar to that of genera of



Figs. 5-8. *A. melanaria*, male genitalia. 5. tegumen, dorso-lateral view; 6. gnathii, ventral view; 7. tip of gnathii, lateral view; 8. saccus and juxta, dorsal view. Figs. 9-13. *A. jaguararia*, male genitalia. 9. uncus, ventro-lateral view; 10. tegumen, lateral view; 11. gnathii, ventral view; 12. tip of gnathii, lateral view; 13. saccus and juxta; dorsal view.



Figs. 14-15. *Arichanna* spp., right valva, inner view. 14. *melanaria*; 15. *jaguararia*.

the *Boarmia* group.

m. 1 (tegumen-uncus): a large muscle (Figs. 1, 2 and 9), arising on dorsal part of tegumen and inserted on ventral edge of uncus.

m. 2 (tegumen-subscaphium): a slender muscle (Figs. 1 and 2), taking its origin on anterior ridge of tegumen and inserted on proximal part of subscaphium.

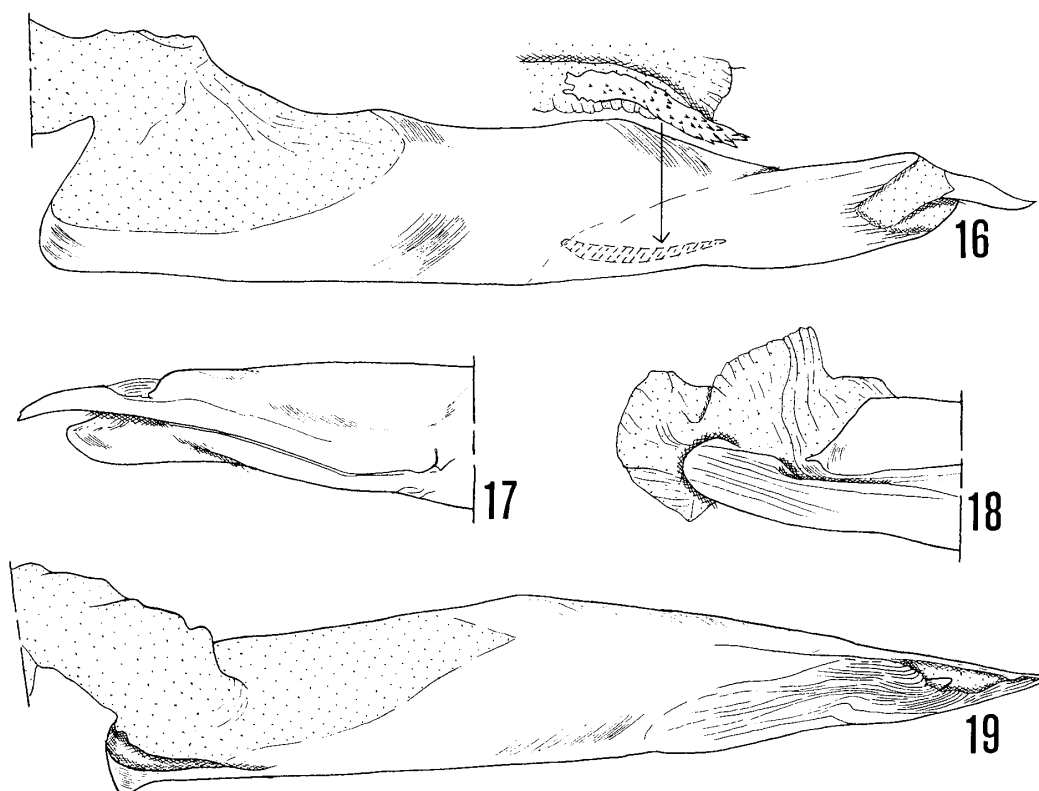
m. 3 (tegumen-transtilla): a rather thin muscle (Figs. 5 and 10), arising on anterior ridge of tegumen and inserted on distal end of transtilla.

m. 4 (tegumen-transtilla): a massive muscle (Figs. 5 and 10), arising on lateral part of tegumen and inserted on basal part of transtilla. The muscle m. 4 is usually present between the vinculum and the transtilla of valva in the ditrysian Lepidoptera, but a corresponding muscle is sometimes between the tegumen and the transtilla in the subfamily Ennominae. In the condition that the tegumen is articulated with the vinculum flexibly as in *Lomographa temerata* ([Denis & Schifferrmüller]) and *Ourapteryx nivea* Butler, m. 4 arises on the vinculum. However, in the genitalia whose tegumen and vinculum are firmly fused each other laterally, m. 4 takes its origin on the lateral part of the tegumen, not on the dorsal part of vinculum.

m. 5 (juxta-harpe): a large muscle (Figs. 8 and 13-15), arising on juxta and inserted on proximal part of harpe which is weakly sclerotized. According to Birket-Smith (1974), m. 5 is the intrinsic valve muscle running from the sacculus to the harpe. But, in some ennomines I examined, e.g. *Dilophodes elegans* (Butler), *Apocleora rimosa* (Butler), *Phthonosema tendinosaria* (Bremer) and *Alcis angulifera* (Butler), the attaching site of m. 5 moves from the sacculus to the juxta. Kuznetsov and Stekolnikov (1987) indicated that the movement of the attaching site of m. 5 (their m. 7) occurred within the subfamily Ennominae.

m. 6 (vinculum-phallus): a long muscle (Figs. 3 and 4), taking its origin on proximal part of aedeagus and inserted on dorso-lateral part of vinculum.

m. 7 (saccus-phallus): a large muscle (Figs. 3 and 4), arising on ventral part of saccus and



Figs. 16-17. *A. melanaria*, phallus. 16. whole aspect ; 17. right terminal end.
Figs. 18-19. *A. jaguararia*, phallus. 18. terminal end ; 19. whole aspect.

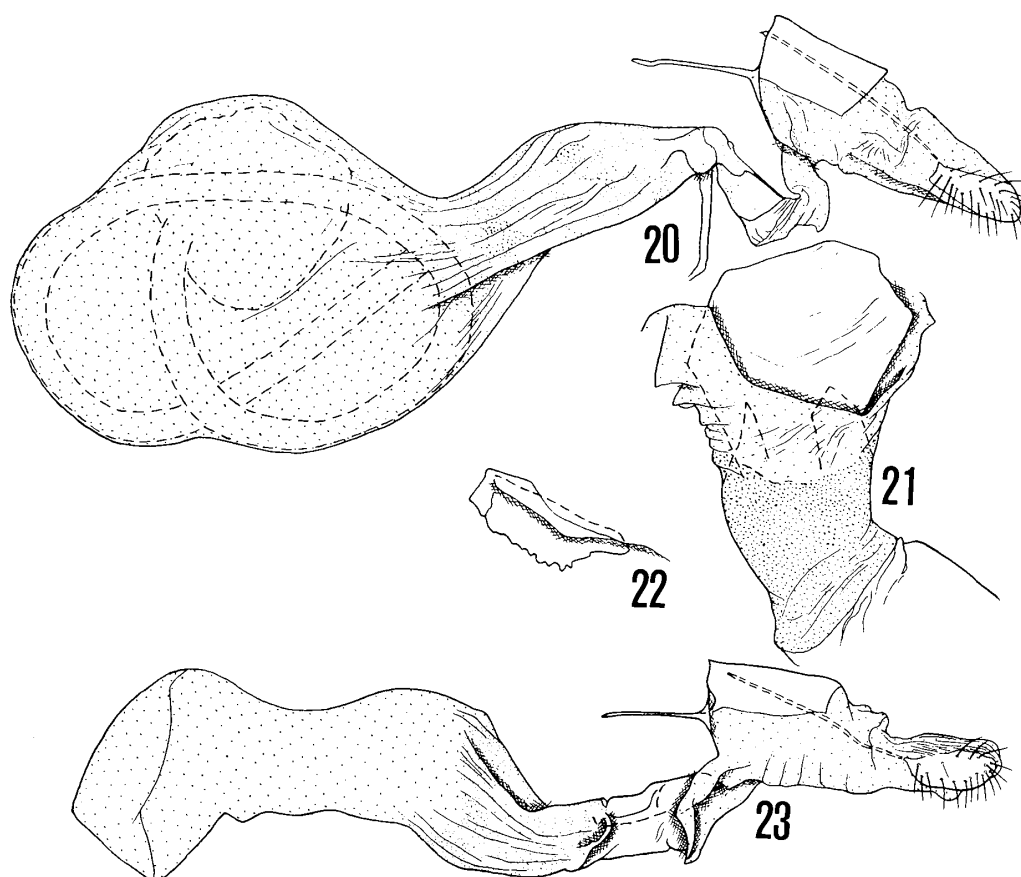
inserted on mid-dorsal part of phallus.

m. 8 (saccus-juxta): a large muscle (Figs. 8 and 13), arising on distal part of saccus and inserted on juxta.

3. Taxonomic comments

Japanense species of the subgenus *Icterodes* have many similarities in the male genital apparatus, but females have few similarities except the ductus bursae having many granules and the small papillae anales which are common in the Ennominae. The subgenus *Icterodes* is closely related to the subgenus *Epicterodes* in the male and female genital characters, but differs from it by the weakly sclerotized harpe. *Icterodes* is also distinguished from the subgenus *Arichanna* by the slender and weakly sclerotized sacculus and from subgenera *Phyllabraxas* and *Paricterodes* by the small swelling ampulla. In the female genitalia, *Icterodes* and *Epicterodes* differ from them in the following point ; corpus bursae with or without a irregular shaped signum in *Icterodes* and *Epicterodes*, but corpus bursae with a circular or subcircular signum surrounded by spines in other subgenera. However, it is doubtful whether *Icterodes* is a monophyletic entity or not, because any genital characters mentioned above are considered to be not autapomorphic.

Holloway (1976) recorded two *Arichanna* species, *A. maculata* Moore, type-species of the subgenus *Dictyodea*, and *A. nigrifasciata* (Warren), from Mt. Kinabalu, North of Borneo, under the subgenus *Icterodes* (his section), and illustrated their male genitalia. But, the finger-like ampulla and bifurcate juxta in his figures are not congruent with the characteristics of male genitalia of *Arichanna*. Inoue (1987) transferred them from *Arichanna* to



Figs. 20-22. *A. melanaria*, female genitalia. 20. whole aspect ; 21. lamella post-vaginalis, ventral view ; 22. signum.

Fig. 23. *A. jaguararia*, female genitalia, whole aspect.

Alcis Curtis, 1826 based on the form of antennal pectination, forewing venation and characteristic signa of female genitalia. His treatment is reasonable.

Key to Japanese species of *Icterodes* based on genitalia

1. Ventro-caudal projection of gnathii short ; valvula with many wrinkles ; terminal spinous projection of phallus long ; cornutus present. Corpus bursae bulbous, with a signum *Arichanna (Icterodes) melanaria* (Linnaeus)
- . Ventro-caudal projection of gnathii long ; valvula without wrinkles ; terminal spinous projection of phallus short ; cornutus absent. Corpus bursae cylindroid without signum *Arichanna (Icterodes) jaguararia* (Guenée)

Arichanna (Icterodes) melanaria (Linnaeus)

Phalaena melanaria Linnaeus, 1758, *Syst. Nat.* (Edn 10) 1: 521.

Male genitalia (Figs. 1, 3, 5-8, 14, 16 and 17). Gnathii (Fig. 6) fused each other ventro-caudally, with a short and rounded ventro-caudal projection (Fig. 7) covered with many small and rounded protuberances. Saccus (Fig. 8) tapering. Juxta narrow except rounded base as in Fig. 8. Valva (Fig. 14) slender ; ampulla developed as a simple protru-

sion, with many curved spines; valvula with many wrinkles. Phallus (Figs. 16–17) with a long spinous projection and a spatulate sclerite at right terminal end; cornutus as in Fig. 16.

Female genitalia (Figs. 20–22). Corpus bursae bulbous, membranous, with a signum (Fig. 22) at right side. Ductus bursae membranous, with many granules. Lamella postvaginalis (Fig. 21) recognized as a large sclerite plate.

Specimens examined. 1 ♂ 2 ♀, Tsukide, Ichihara C., Chiba Pref., 8. VI. 1991 (S. Hashimoto); 1 ♂, Kiyosumi, Amatsukominato T., Chiba Pref., 27. V. 1990 (S. Hashimoto).

Remarks. *A. melanaria* is distinguished from *A. jaguararia* by the characters given in the key. Japanese *melanaria* is divided into two subspecies, one of them is *fraterna* (Butler), type-species of *Icterodes* Butler (1878), the other is *askoldinaria* (Oberthür). The former subspecies here dealt with is known from Hokkaido, Honshu, Shikoku and Kyushu, and the latter is known from Tsushima Is., in Japan.

Arichanna (Icterodes) jaguararia (Guenée)

Rhyparia jaguararia Guenée, 1857, in Boisduval & Guenée, *Hist. nat. Insectes* (Lépid.) **10**: 198.

Male genitalia (Figs. 2, 4, 9–13, 15, 18 and 19). Gnathii (Fig. 11) fused each other ventrally, with a long and pointed ventro-caudal projection (Fig. 12) covered with many small and pointed protuberances on upperside. Saccus (Fig. 13) rounded. Juxta as in Fig. 13. Valva (Fig. 15) slender; valvula without wrinkles. Phallus (Figs. 18 and 19) with a tiny spinous projection and a spatulate sclerite at terminal end.

Female genitalia (Fig. 23). Corpus bursae membranous, cylindroid, without any signum. Ductus bursae with many granules. Lamella postvaginalis not developed.

Specimens examined. 2 ♀, Mt. Takago, Kimitsu C., Chiba Pref., 8. VII. 1990 (S. Hashimoto); 4 ♂ 4 ♀, Fudago, Kimitsu C., Chiba Pref., 28. VI. 1990 (S. Hashimoto); 7 ♂, Kojin, Wakayama Pref., 9. VII. 1984 (S. Hashimoto); 1 ♂ 1 ♀, Shioiri, Kagawa Pref., 6. VII. 1979 (S. Hashimoto).

Remarks. *A. jaguararia* falls into two subspecies, *gaschkevitchii* (Motschulsky) known from Hokkaido, Honshu, Shikoku and Kyushu, and *diminuta* Inoue known from Yakushima Is. The specimens studied here belong to the subspecies *gaschkevitchii* (Motschulsky).

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摘 要

日本産 *Arichanna* 属 2 種の交尾器の記載と *Icterodes* 亜属の雄交尾器筋肉系と亜属の分類学上のコメント (橋本里志)

Arichanna 属は、5 亜属、約 90 種の記載種からなる大きな群であり、主に東南アジアに分布している。日本からは 5 種が知られ、*A. tetrica* (Butler) キジマエダシャク、*A. pryeraria* Leech プライヤエダシャク、*A. albomaculata* Leech シロホシエダシャクの 3 種は *Arichanna* 亜属に、*A. melanaria* (Linnaeus) キシタエダシャクと *A. jaguararia* (Guenée) ヒョウモンエダシャクの 2 種は *Icterodes* 亜属に属する。本論文では、*Icterodes* 亜属に属する 2 種の交尾器の記載を行った。さらに、*Icterodes* 亜属の雄交尾器筋肉系を記載し、亜属の分類学上のコメントを記した。

Icterodes 亜属の雄交尾器筋肉系は、エダシャク亜科の *Boarmia* group の筋肉系と基本的に同一であり、筋肉 m. 4 の付着部位が vinculum から tegumen に、m. 5 の付着部位が valva の sacculus から juxta に移動するという特徴が観察された。

Icterodes 亜属は雌雄交尾器の形質において、*Epicterodes* 亜属に近縁であるが、雄交尾器の harpe が強く硬化しないことにより、*Epicterodes* 亜属から区別される。*Arichanna* 亜属からは、硬化の程度が弱く細長い sacculus により、*Phyllabraxas* 亜属と *Paricterodes* 亜属からは、コブ状の ampulla を持つことにより、それぞれ区別される。

Icterodes 亜属に属する日本産 2 種の雄交尾器は互いに似ているが、雌交尾器ではかなりの違いが見られた。しかも、雄交尾器に見られる類似は、本亜属の固有新形質ではないと考えられ、本亜属が単系統群であるかどうかは疑問である。

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